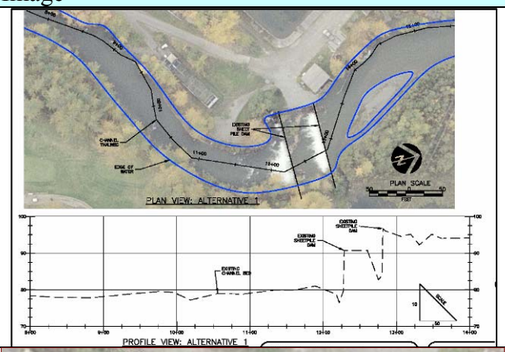
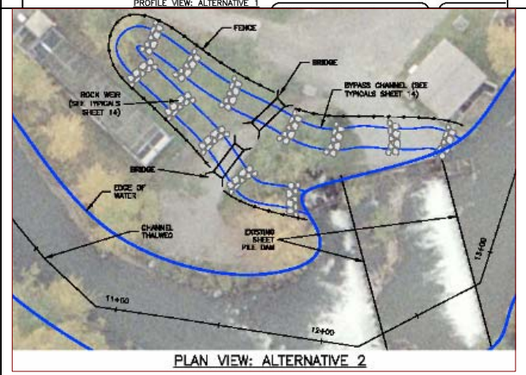
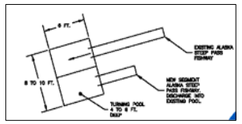
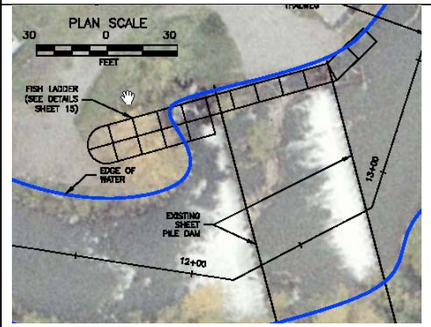
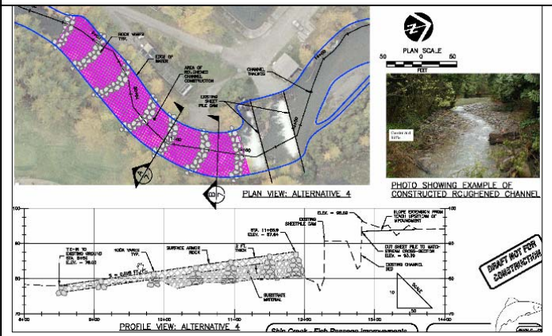
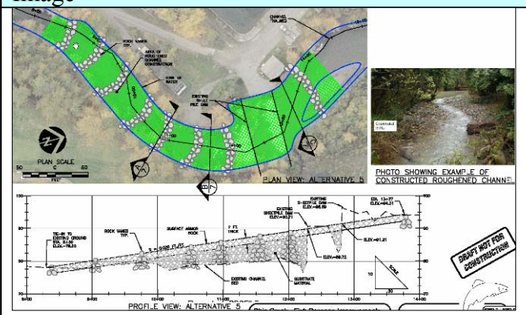
Elmendorf Dam - Fish passage alternatives summary

Note: 1 - Estimates are only intended to provide planning level comparison between alternatives. Quantities and cost estimates are for construction only and are based on concepts of Alternatives, rough estimates of volumes and typical unit prices. More detailed feasibility, design/analysis and estimates of quantities and cost will be required for preferred alternative.

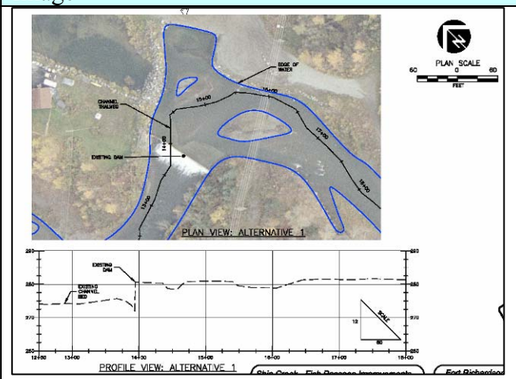
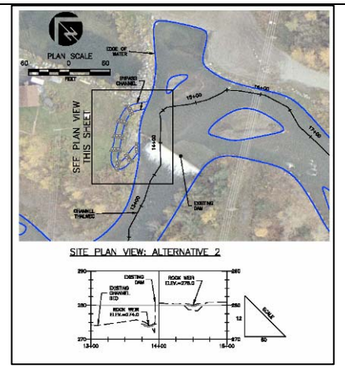
Alternative/Cost	Image	Impacts	Pros	Cons
Alt 1 – do nothing Construction cost estimate[1] = $0		•Passage - of adult salmon and adult and juvenile resident fish would remain blocked by the downstream dam. •Channel stability – sediment deposition would continue to occur upstream with maintenance of the intake required. The downstream channel would be expected to continue to incise through erosion of the bed and banks. •Debris/ice – existing conditions of debris and ice blockage and damage would not be changed. Continued maintenance of the intake structure would be required. •Ground water elevations – no change	•Fish are prevented from passing to upstream reaches, limiting human-bear conflicts and fish-borne nuisances. •No design, permitting or construction cost	•Fish are prevented from accessing upstream reaches and habitats. •Sediment deposition in impoundments and erosion below Elmendorf dam will be expected to continue.
Alt 2 - Bypass Channel Construction cost estimate[1] = $550,000		•Passage - would be improved for adult salmon and adult and juvenile resident fish during the migration period with the ability to manage fish access to upstream reaches. •Channel stability – negligible change to existing conditions along Ship Creek •Debris/ice – existing conditions would continue with debris/ice impacts to the inlet. •Ground water – stream levels will be essentially unchanged. No change to existing ground water – surface water interactions would be expected with the exception of some increase in infiltration from the bypass channel should it be unlined.	•Fish would be provided an improved route for upstream passage. The 1-ft jump height proposed would be easily negotiated by adult salmon and adult resident fish. Construction of weirs using boulders would provide multiple flow paths across each drop that should enable juvenile resident fish passage. •The channel outlet located in the scour pool at the base of the dam would provide good fish attraction and ability to locate the entrance to the bypass channel. •Flow along the channel can be managed by opening and closing the head gate allowing active management of fish passage to upstream reaches of Ship Creek. •Location on the north side of Ship Creek would reduce impacts to mature riparian forest, golf course and large pond along the opposite side. In addition, location would provide good access for operation and maintenance. •Bypass channel alignment and features could be modified for opportunities for trapping and collection of brood stock or flow routing into the brood pond. •Improved public viewing. •Limited modification of the existing dam structure. •Negligible change to flow and hydraulics of Ship Creek. No change to ground water – surface water interaction; except locally to the bypass channel. No impact to regulatory water surface elevations is anticipated.	•Bypass channel inlet will be susceptible to sedimentation, debris and icing. •Channel will require active operation and maintenance. •Construction of bypass channel will encroach on existing land surfaces and may require additional structural strengthening of intake building, access roads and channel-sheet pile interface. •Conflict of channel with existing structures and utilities will need to be further analyzed. •Sediment deposition in impoundments and erosion below Elmendorf dam will be expected to continue. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.

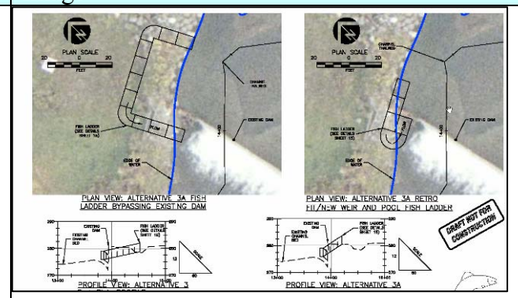
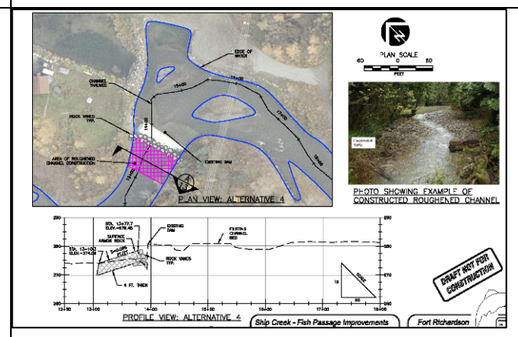
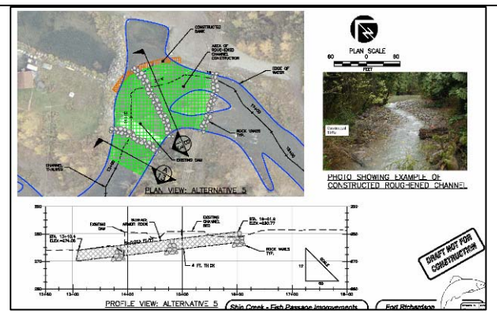
Alternative/Cost	Image	Impacts	Pros	Cons
Alt 3 (opt. 1) – extend existing Aaska Steep Pass Fishway Construction cost estimate[1] = $190,000	 	•Passage – would be improved for adult salmon with management of fish access to upstream reaches possible. The ability of adult resident fish to pass the ASP is not known. Juvenile resident fish would not be able to pass the ASP. •Channel stability – no change. •Debris/ice – existing conditions of debris and ice blockage and damage would not be changed. Active O&M would be required. •Ground water elevations – no change	•Fish passage would be enabled. •Management of fish access to upstream reaches would be easily implemented. •Relatively inexpensive for design, permitting and construction. •Little in stream impact.	•May only serve as a short-term or interim measure. •Susceptible to sediment, debris and ice blockage and damage. Will require active O&M. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.
Alt 3 (opt.2) – retrofit new fish ladder Construction cost estimate[1] = $890,000		•Passage – would be improved through the fish ladder for adult salmon and resident fish with management of fish access to upstream reaches possible. Passage would be difficult to impassable for resident juvenile fish. •Channel stability – flow depths and velocities along Ship Creek will be nearly unchanged from existing conditions. Stability of the new fish ladder would be included as a design task. •Debris/ice – the ladder will be susceptible to debris and ice and will require ongoing O&M. •Ground water elevations – water levels along Ship Creek will not be changed. Therefore, no change in the surface water - ground water dynamic is anticipated.	•Fish passage would be provided through the fish ladder. •Operation of the fish ladder would allow active management of fish passage to upstream reaches. •The fish ladder can be configured to include a fish trap if desired.	•Fish ladder is a comparatively large construction effort. •Fish ladder will require a retrofit to the older dam structure. The dam was observed to be in good condition. Additional evaluation of expected service life of the ladder and dam is recommended to establish feasibility. •Fish ladder is susceptible to debris, sediment and ice blockage and damage. •Active O&M will be required. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.
Alt 4 – partial dam removal Construction cost estimate[1] = $1,400,000		•Passage – would be improved by reducing jump heights to 3-ft or less, easily passable by healthy adult Chinook and Coho. This height may be passable for adult resident fish but would be effectively impassable for juvenile resident fish. The upstream weir could be notched providing a moderately-difficult to difficult passage obstacle. Otherwise, management of fish access to upstream reaches is not possible. •Channel stability – design of the armor rock and rock vanes would account for foreseeable hydraulic and icing conditions. Upstream of the dam an apparently stable slope was identified and extended through the dam impoundment. The upper weir would be cut to this elevation and act as a grade control to upstream reaches. Channel stability should be confirmed during analysis and design at later phases •Debris/ice – may more easily pass with less obstruction. If the upper weir notch is controlled, there will be additional obstructions to collect debris and ice. On going O&M should be expected. •Ground water – complete removal of the dam causes an average decrease in ground water elevation of 3.6-ft for the deep aquifer (ref: Appendix 7.5). This reach is a gaining stream – shallow aquifer levels would be higher than the stream with draw downs localized to stream bank areas.	•Adult salmon and possibly adult resident fish would be able to easily jump the two dams and access upstream reaches. •Provide continuity of stream process •Reduced risk of debris or ice blockage or damage for the full width notching of the upper weir. (Risk increases if the notch is controlled due to obstructions by flash boards or head gate.) •Ongoing O&M cost may be less than existing conditions for the full width notching option. However, a monitoring program should be implemented to track the performance of the roughened channel.	•Management of fish access to upstream reaches would be reduced or impossible. •Extensive construction in stream. •Though the design phase would include tasks to address these there will continue to be risk of ice, debris, flood flows eroding the roughened channel materials or stream bank. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.

Alternative/Cost	Image	Impacts	Pros	Cons
Alt 5 – full dam removal Construction cost estimate[1] =$2,225,000		•Passage – would be improved for adult salmon and adult and juvenile resident fish by removing jump obstacles. Management of fish access to upstream reaches is not possible. •Channel stability – design of the armor rock and rock vanes would account for foreseeable hydraulic and icing conditions. Upstream of the dam an apparently stable slope was identified and extended through the dam impoundment. The roughened channel would extend to meet this slope extension. Channel stability should be confirmed during analysis and design at later phases •Debris/ice – may more easily pass with less obstruction. •Ground water – complete removal of the dam causes an average decrease in ground water elevation of 3.6-ft for the deep aquifer (ref: Appendix 7.5). This reach is a gaining stream – shallow aquifer levels would be higher than the stream with draw downs localized to stream bank areas.	•Fish would be able to swim along the roughened channel and access upstream reaches. •Provide continuity of stream process •Reduced risk of debris or ice blockage or damage through reduction of obstructions into the stream channel. •O&M cost is anticipated to be reduced. However, a monitoring program should be implemented to track the performance of the roughened channel.	•Management of fish access to upstream reaches would not be possible. •Extensive construction in stream. •Though the design phase would include tasks to address these there will continue to be risk of ice, debris, flood flows eroding the roughened channel materials or stream bank. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.

Fort Richardson Dam - Fish passage alternatives summary

Note: 1 - Estimates are only intended to provide planning level comparison between alternatives. Quantities and cost estimates are for construction only and are based on concepts of Alternatives, rough estimates of volumes and typical unit prices. More detailed feasibility, design/analysis and estimates of quantities and cost will be required for preferred alternative.

Alternative/Cost	Image	Impacts	Pros	Cons
Alt 1 – do nothing Construction cost estimate[1] = $0		•Passage - would be unchanged from existing conditions. •Channel stability – little change from existing conditions would be anticipated. Gravel bar formation and lateral change in active channel location would be expected to continue upstream. Potential for lateral migration of Ship Creek along reaches upstream and downstream of the dam exists and would be consistent with natural geomorphic dynamics. •Debris/ice – existing conditions of debris and ice blockage and damage would not be changed. •Ground water elevations – no change.	•Salmonids are currently prevented from reaching the Fort Richardson Dam by the Elmendorf barrier. However, if salmonids were present, adults would be able to pass this impediment with moderate difficulty. •No construction or O&M cost •No change to operation	•Fish are limited by the passage impediment in accessing upstream reaches and habitats. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts. •Sediment deposition in the impoundments may increase risk of stream bank erosion above the dam.
Alt 2 - Bypass Channel Construction cost estimate[1] = $195,000		•Passage – would be improved for adult salmon and adult and juvenile resident fish during the migration period with the ability to manage fish access to upstream reaches. •Channel stability – negligible change to existing conditions along Ship Creek •Debris/ice – existing conditions would continue with debris/ice impacts to the inlet. •Ground water – stream levels will be essentially unchanged. No change to existing ground water – surface water interactions would be expected, with the exception of slight increase in infiltration from the bypass channel should it be unlined.	•Fish would be provided an alternate route for upstream passage. The 1-ft jump height proposed would be easily negotiated by adult salmon and adult resident fish. Construction of weirs using boulders would provide multiple flow paths across each drop that should enable juvenile resident fish passage. •The channel outlet located in the scour pool at the base of the dam would provide good fish attraction and ability to locate the entrance to the bypass channel. The 1-ft jump height proposed would be easily negotiated by adult salmon and adult resident fish. Construction of weirs using boulders would provide multiple flow paths across each drop that should enable juvenile resident fish passage. •Flow along the channel can be managed by opening and closing the head gate allowing active management of fish passage to upstream reaches of Ship Creek. •Location on the north side of Ship Creek would improve convenience of construction and O&M. Location along the outside of the bend is expected to improve the likelihood of the active channel passing the bypass channel inlet. •Limited modification of the existing dam structure. •Negligible change to flow and hydraulics of Ship Creek. No change to ground water – surface water interaction; except locally to the bypass channel. No impact to regulatory water surface elevations is anticipated.	•Bypass channel inlet will be susceptible to sedimentation, debris and icing. •Dynamic formation and movement of gravel bars may block inlet to bypass channel. •Channel will require active operation and maintenance. •Construction of bypass channel will encroach on existing land surfaces and may require additional strengthening of berm. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.

Alternative/Cost	Image	Impacts	Pros	Cons
Alt 3 (opt. 1) – Retrofit new fish ladder Construction cost estimate[1] = $540,000 bypass = $595,000 instream		•Passage - would be improved through the fish ladder for adult salmon and resident fish with the ability to manage fish access to upstream reaches. Passage would be difficult to impassable for resident juvenile fish. •Channel stability – negligible change to existing conditions along Ship Creek •Debris/ice – existing conditions would continue with debris/ice impacts to the inlet. •Ground water – stream levels will be essentially unchanged. No change to existing ground water – surface water interactions would be expected with the exception of slight increase in infiltration from the bypass channel should it be unlined.	•Fish would be provided an alternate route for upstream passage. •The fish ladder outlet located in the scour pool at the base of the dam would provide good fish attraction and ability to locate the fish ladder. •Flow along the ladder can be managed by opening and closing the head gate allowing active management of fish passage to upstream reaches of Ship Creek. •Location on the north side of Ship Creek would improve convenience of construction and O&M. Location along the outside of the bend is expected to improve the likelihood of the active channel passing the bypass channel inlet. •For the ladder bypass option, limited modification of the existing dam structure. •Negligible change to flow and hydraulics of Ship Creek. No change to ground water – surface water interaction; except locally to the bypass channel. No impact to regulatory water surface elevations is anticipated.	•Existing dam is passable with moderate difficulty. Thus, the need for a fish ladder should be carefully considered. •Modifications to retrofit a ladder to the existing dam will require design and construction to maintain or improve the integrity of the dam. •Age and service life of the ladder and dam will be very different. •Fish ladder inlet and structure will be susceptible to sedimentation, debris and icing. •Dynamic formation and movement of gravel bars may block inlet to bypass channel. •Ladder will require active operation and maintenance. •Construction of bypass ladder will encroach on existing land surfaces and may require additional strengthening of berm. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.
Alt 4 – Raise tail water elevation reducing jump height Construction cost estimate[1] = $450,000		•Passage – would be improved by reducing jump heights to 3-ft or less, easily passable by healthy adult Chinook and Coho. This height may be passable for adult resident fish but would be effectively impassable for juvenile resident fish. Management of fish access to upstream reaches is not possible. •Channel stability – design of the armor rock and rock vanes would account for foreseeable hydraulic and icing conditions. •Debris/ice – may more easily pass with less obstruction. •Ground water – The existing dam remains in place with the tail water elevation increased. Therefore, minimal impact to ground water is anticipated.	•Reduced jump height would reduce the degree of difficulty for passage for adult salmon and possibly adult resident fish. (The dam would remain a barrier to juvenile resident fish.) •With the exception of the option to install a low sill at the dam crest in increase swimming depth, no modifications would be made to the existing dam structure. •Provide continuity of stream process •Reduced risk of debris or ice blockage or damage. •Little O&M cost	•Management of fish access to upstream reaches would be reduced or impossible. •Extensive construction in stream. •Risk of ice, debris, flood flows eroding the roughened channel materials or stream bank. •Sediment deposition in impoundments and erosion below dam will be expected to continue. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.
Alt 5 – full dam removal Construction cost estimate[1] = $1,500,000		•Passage – would be improved for adult salmon and adult and juvenile resident fish by removing jump obstacles. Management of fish access to upstream reaches is not possible. •Channel stability – design of the armor rock and rock vanes would account for foreseeable hydraulic and icing conditions. Upstream of the dam an apparently stable slope was identified and extended through the dam impoundment. The roughened channel would extend to meet this slope extension. Channel stability should be confirmed during analysis and design at later phases. •Debris/ice – may more easily pass with less obstruction. •Ground water – The existing dam would be removed with a lowering of water surface elevation. Reductions in ground water levels will average about 1.4-ft with a maximum reduction near the dam of about 1.8-ft (ref: Appendix 7.5).	•Fish would be able to swim along the roughened channel and access upstream reaches. •Provide continuity of stream process •Reduced risk of debris or ice blockage or damage through reduction of obstructions into the stream channel. •O&M cost is anticipated to be reduced. However, a monitoring program should be implemented to track the performance of the roughened channel.	•Management of fish access to upstream reaches would not be possible. •Extensive construction in stream. •Though the design phase would include tasks to address these there will continue to be risk of ice, debris, flood flows eroding the roughened channel materials or stream bank. •Fish access to upstream reaches would increase risk of fish borne nuisances and bear/human conflicts.